WQ Manager Meeting
Customs House R.210

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Columbia/Snake Mainstem Temperature TMDL Implementation Short Term Plan

TMDL ISSUANCE TO 2010

Implementation, first decade

- RPA temperature projects have first priority
- Determine performance compared to load allocations
- Develop and Implement Temperature Management Plans, each dam
- Workgroup establishes feasibility criteria and prioritizes operational systemwide options
- Look ahead for ways to change the eventual temperature targets

RPA temperature items have first priority

- Already required and underway
- Making progress
- No desire to question appropriateness of those RPAs
- Focus is on fish, not cross sectional average temperature

Temperature increases compared to load allocations

- Metrics developed by workgroup – how measured? protocols
- Monitoring protocols developed in workgroup
- Triggers for Temperature Management Plans
- Formalized in the Detailed Implementation Plan

Develop and Implement Temperature Management Plans

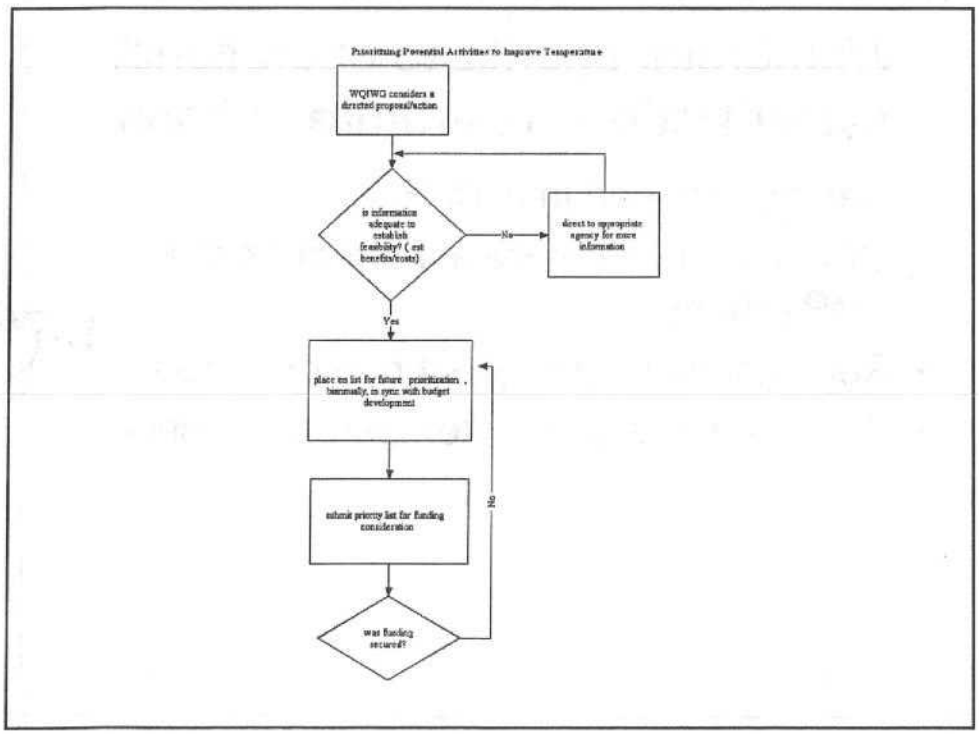
- Monitoring systems in place by 6/04
- Compare performance to LAs, 11/05
- If not meeting LAs, submit TMP to primary state by 3/06
- Compare performance to LAs, 11/08
- If not meeting LAs, submit TMP to primary state by 3/09

Workgroup prioritizes operational systemwide temperature options

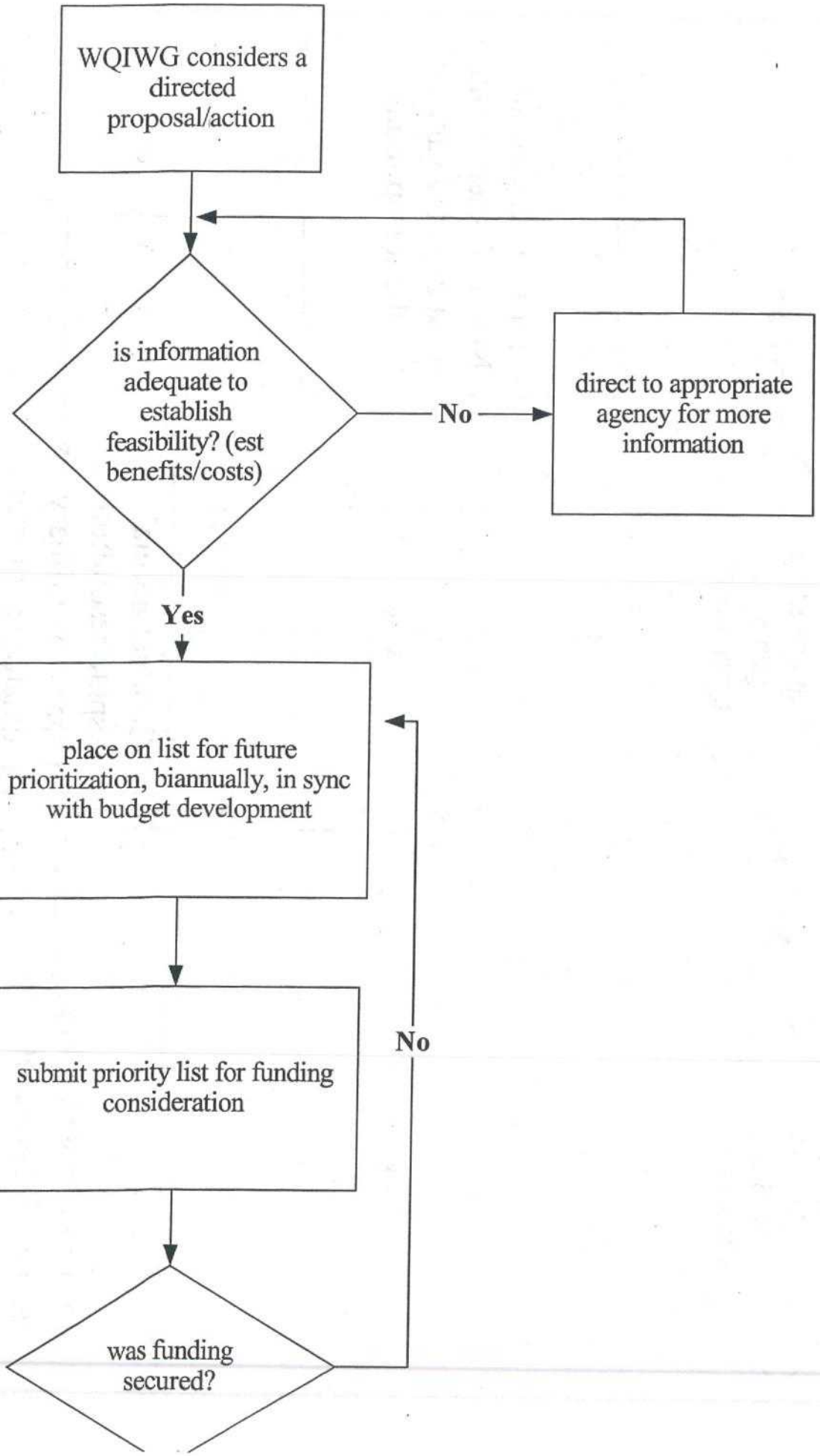
- Can be included in a TMP
- Otherwise not enforceable through the TMP process
- Regional funding request reinforcement – important role (Mathew)
- Forum for operational temperature options

Look ahead for ways to change the eventual temperature targets if its appropriate

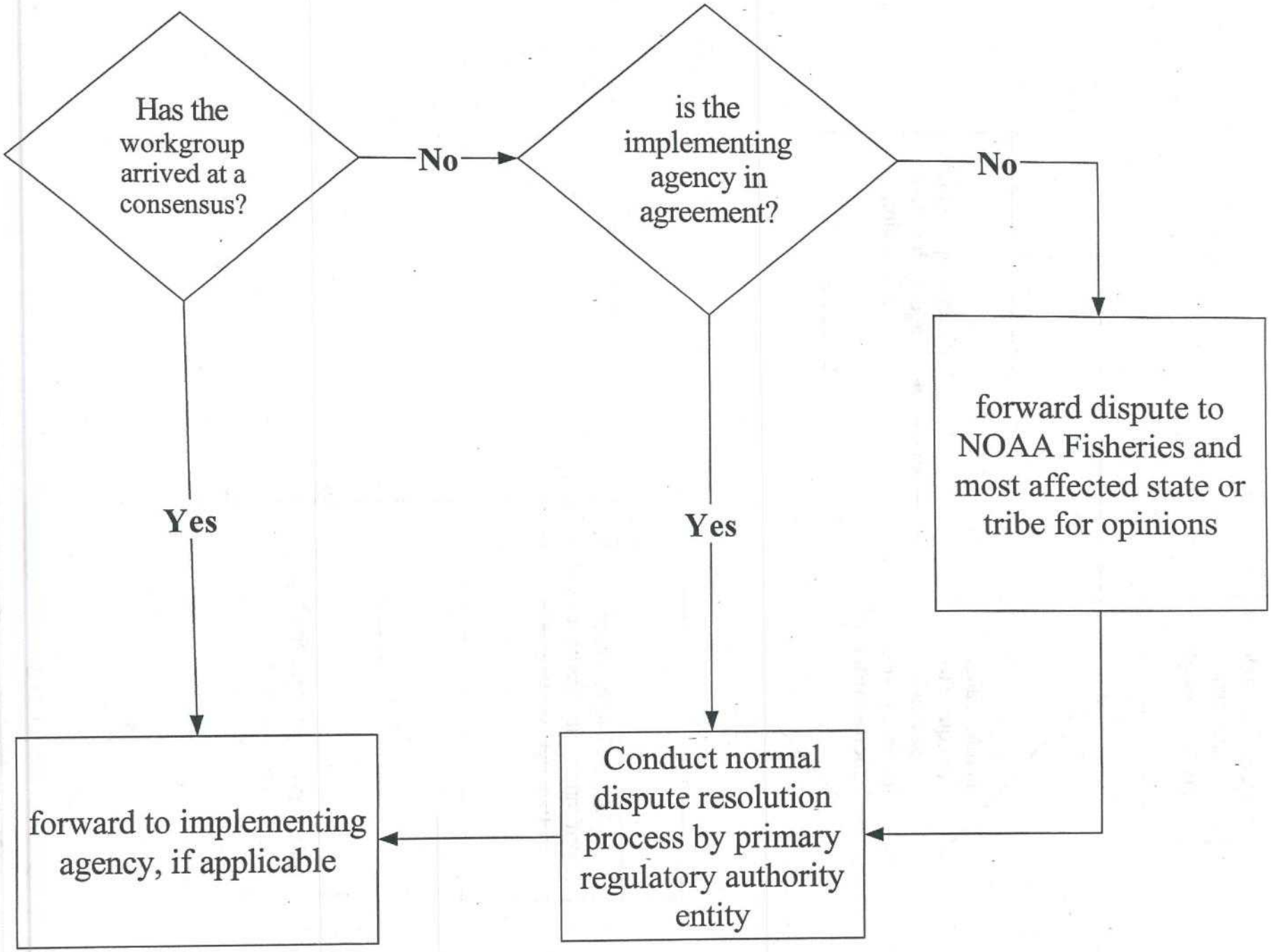
- Use Attainability Analysis
- Gather the right data
- Explore the possibilities
- Prepare the states and EPA for possible criteria changes
- Seek consistent criteria



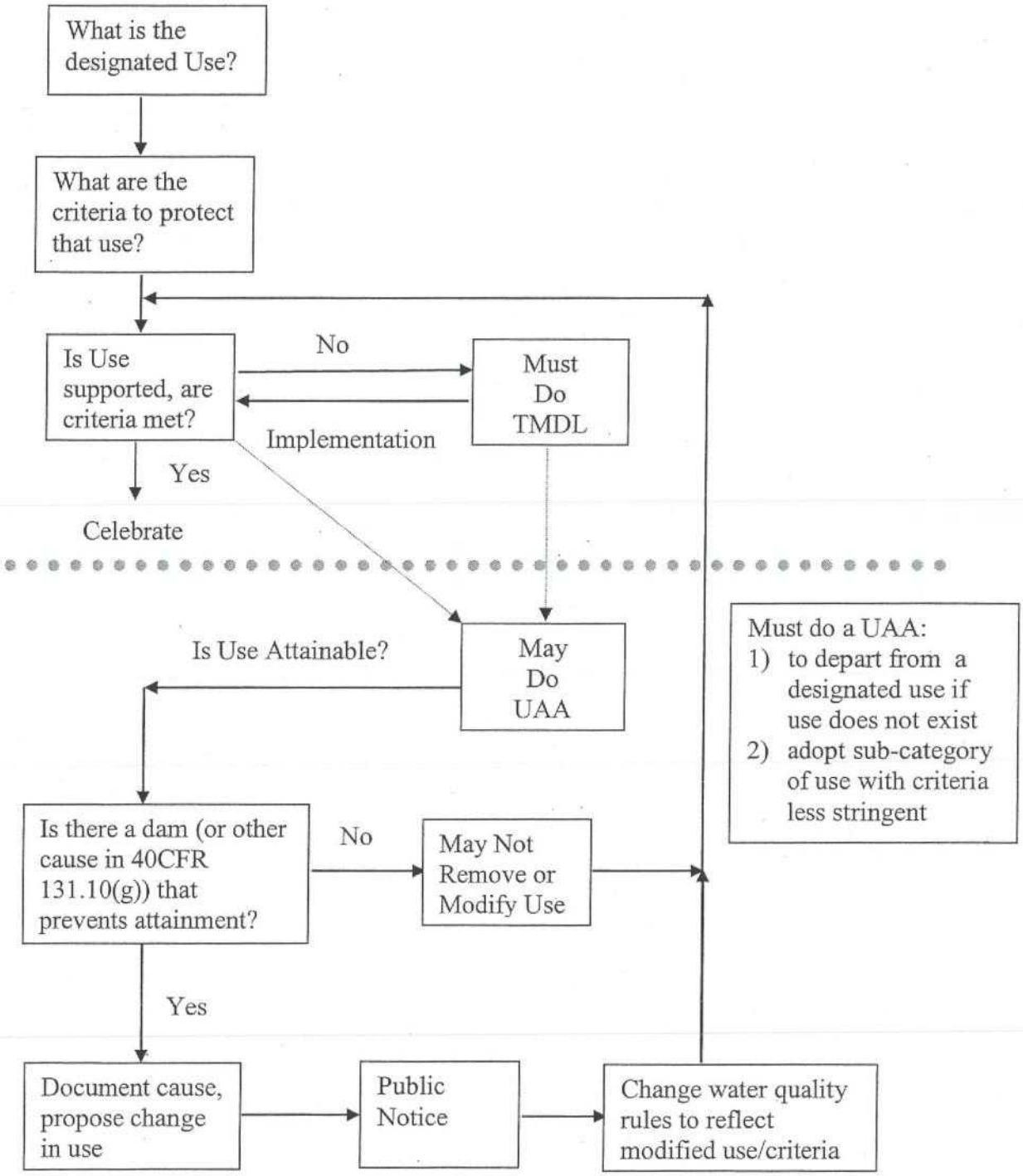
Prioritizing Potential Activities to Improve Temperature



Dispute Resolution



Use is designated in rule



Summary Implementation Strategy

Overview

The goal of the temperature TMDL for the Columbia/Snake River mainstem is to establish load and wasteload allocations that if achieved, would enable the rivers to meet the applicable water quality standards for temperature established by the Colville Tribe and the states of Oregon and Washington. The goal of water quality standards is to protect beneficial uses of the river. The most temperature-sensitive use is providing suitable habitat that supports propagation of anadromous salmonids. These species are particularly vulnerable to degraded temperature conditions during certain times of the year. Some of the anadromous species use the mainstem rivers for spawning and rearing, and all anadromous fish use the mainstem rivers for migrating downstream as juveniles and returning upstream as adults.

The temperature TMDL identifies the increased solar radiation in reservoirs formed upstream of the dams along the mainstem as the main sources of increased average thermal load in excess of site potential during the summer and fall seasons. The dams are the main focus of the implementation strategy although the point source inputs of thermal load are also addressed through routine updates of permit conditions.

The implementation plan for a TMDL contains the actions that will be taken to achieve the water quality standards, a schedule for implementing the actions, benchmarks of success, a monitoring plan, and feedback mechanisms for iterative management. For the Columbia/Snake River mainstem Temperature TMDL, the Implementation Plan will be complex and a number of years in the making. This is because the TMDL identifies temperature improvements at many of the dams on the rivers as necessary to achieve WQS. The development and implementation of feasible temperature improvement measures at the dams will require studies, time and resources. Determination of the feasible alternatives will also require the cooperation and coordination of the dam operators, the states and indian tribes responsible for TMDL implementation, the Federal Agencies that implement the Endangered Species Act and the thirteen other Indian Tribes of the Columbia Basin.

This Summary Implementation Strategy (SIS), which will be issued concurrently with the TMDL, includes an initial list of actions for improving temperature at the dams. However, many of these actions are studies to clarify issues, design improvement measures, or quantify the benefits of improvement measures. So the list of improvement actions, which constitutes the initial implementation plan, will change as studies are finalized and decisions made. The implementation plan will therefore be dynamic. To manage this dynamic implementation plan, this SIS includes an interagency management process and structure . The process and activities described in the SIS may be revised with the issuance of the Detailed Implementation Plan (DIP) in the future.

The TMDL found that temperature improvements at the point sources on the river will

not significantly contribute to attainment of the water quality standards. While temperature improvements from nonpoint sources will improve water temperature in the mainstems, they will not remedy the temperature problems cause by the impoundments formed behind the dams. Improvement of temperature at the dams is necessary to achieve water quality standards. The dam operators believe that the level of improvement at the dams called for by the TMDL is probably not achievable for the entire mainstem. If that is the case, current water quality criteria will not be attained. At that point, amendment of the water quality standards either through site specific criteria or a use attainability analysis would be appropriate.

Further, this SIS lays out an agreement process between the states and the tribes with jurisdiction over water quality standards and the federal agencies and public utility districts that operate the dams and manage the hydropower system. This process is for developing recommendations to improve river temperature and meet the standards for temperature.

This SIS contains the following components:

- An initial implementation strategy in the form of a list of actions to be taken or studies to be conducted to improve temperature degradation caused by dams, including time frames and lead responsibility;
- An interagency management process for iterative management of the Implementation Plan;
- An agreement process between the water quality agencies and the dam operators to document that the dams are in compliance with the Clean Water Act or working toward compliance through the mechanisms laid out in the Clean Water Act.

Participants

The governmental agencies responsible for dam operation or hydropower management, state federal and tribal agencies that have implementing authority or an interest in improving temperatures in the mainstem all participate in the development of the DIP and alternatives for system and individual dam operation.

Initial Implementation Plan

In December 2000, the National Marine Fisheries Service released a Biological Opinion (BiOp) on the operation of the Federal Columbia River Power System (FCRPS) under the federal Endangered Species Act for 12 listed species in the Columbia and Snake Rivers. The Opinion recognizes the importance of temperature improvements in protecting endangered species by requiring specific actions in the Reasonable and Prudent Alternatives, and recommending actions identified as Conservation Recommendations.

Many of the short term actions were specified as part of the RPA in the BiOp. The activities and studies for improving river temperature that are already in place due to the BiOp will constitute

the core of initial short term actions to also demonstrate ongoing compliance with the CWA.

Table 1 includes specific implementation actions that will be considered during the short term

Table 1: Initial Short-term Implementation Activities

2000 Biological Opinion Action Item Description	Completion Date	Action Item #
Dworshak Reservoir coldwater releases		19, 33
Evaluation of temperature effects and adult migratory behavior from Dworshak drafting		34
Develop means to supply cooler water at high temperature portions of fishways		114
Comprehensive depth and temperature investigation to characterize direct mortality sources		115
Operate the four lower Snake River reservoirs within one foot of MOP from April through October		20
Assess the long-term impacts of water temperature on juvenile fish survival		141
Examine relationships among juvenile mortality, temperature, river flow rates, and unit operations at McNary Dam, possible hydrothermal CFD modeling.		142
Model the water temperature effects of alternative Snake River operations.		143

The initial implementation plan is divided into short term and potential long term actions. Short term actions will also involve developing system-wide operational strategies that reduce water temperatures and researching methods to meet the load allocations and improving water quality in fish passage habitat in accordance with the National Marine Fisheries Service's Biological Opinion. Fish passage structures can cause localized exceedances of the temperature standard but since they are essential for the survival of the listed species, measures that provide cooler water within those structures are a high priority for both ESA and CWA compliance.

The Biological Opinion also contains Appendix B "Development of a Water Quality Plan for the Columbia River Mainstem: a Federal Agency Proposal." The water quality plan called for in the document is currently being developed by an interagency workgroup. The workgroup (The

Water Quality Planning Team) has identified additional actions that may be taken to improve temperature at the dams and studies that should be conducted to clarify issues, design improvement measures, or quantify the benefits of improvement measures. They are included in Table 2.

Table2: Potential Long-term Implementation Activities

Realign water intakes at Grand Coulee Dam		
Alter the flood control curves		
Investigate the cool water releases from Canadian hydro projects		
Investigate the cool water releases from the Hell's Canyon hydro projects		
Identify water temperature cooling and avoidance of heat increase methods at individual hydro projects		
Investigate selective operation of the Grand Coulee powerhouses for cooling		
Investigate selective warm water withdrawals from Lk Roosevelt to Banks Lake		
Investigate penstock selective withdrawals at Grand Coulee Dam		

Potential long term actions require further study but include structural alterations and implementation of operational changes to dams to improve temperature in the rivers. Long term actions will also, if necessary, involve conducting a Use Attainability Analysis (UAA) to develop a subcategory for fish propagation of the Columbia and Snake Rivers, describing the habitats for fish passage, fish spawning and rearing, and fish holding locations within the rivers and the temperatures needed to support those uses. This analysis may be conducted in concert with ESA consultation.

Interagency Management Process

An interagency Water Quality Implementation Plan Workgroup will be developed to manage the system-wide implementation plan. The workgroup will form within one year after

finalization of the TMDL and be chaired on a rotating basis by the States of Oregon and Washington and Colville and Spokane Tribes. Members will include the participants listed below who choose to participate.

Confederated Tribes of the Colville Reservation
Spokane
Nez Perce
Yakama
Umatilla
Idaho Department of Environmental Quality
Oregon Department of Environmental Quality
Washington Department of Fish and Wildlife
Washington Department of Ecology
U.S Environmental Protection Agency
U.S. Army Corps of Engineers
Bonneville Power Administration
Bureau of Reclamation
NOAA Fisheries
U.S. Fish and Wildlife Service
Grant County PUD
Chelan County PUD
Douglas County PUD

Inclusion of all these parties will facilitate coordination of this implementation plan with activities required under the BIOP and other basin wide efforts. The activities of this committee will be as follows:

- Monitor completion of required improvement actions and studies;
- Work with lead agency managers to ensure actions are completed on time;
- Establish due dates when not already established in Table 1;
- Evaluate study results;
- Accept studies or ask for changes;
- Make decisions on proceeding with actions based on study results;
- Make decisions on whether actions are feasible based on study results;
- Oversee a joint WQS revision process if appropriate in the future.

The participants will staff the committee and participate in the decision making. Decision making will preferably be by consensus but the ultimate decision will be up to the state and tribe with jurisdiction.

1. Consensus will be attempted by adhering to a decision making process developed during the initial meetings of the Implementation Group.
2. One of the first implementation tasks is to develop the criteria by which temperature reduction proposals will be prioritized.
3. Temperature reduction studies and actions that are requirements of the BiOp

will be the primary focus for implementation.

The members will make all reasonable efforts to achieve consensus. When consensus cannot be achieved in the group, the objecting member may request that the issue be elevated to the state or tribe with jurisdiction.

There are a number of committees or groups already in existence working on this issue.: the Water Quality Team, the Water Quality Plan Group and the implementation plan group. The committee could be a combination of the three groups and perhaps serve the purposes of all three.

Agreement Process between Water Quality Agencies and Dam Operators:

Agreement between dam operators and water quality agencies is a statement by the water quality agency that the operator is doing what needs to be done to comply with the Clean Water Act. These agreements can be documented in three ways:

1. 401 Certification for non-federal dams;
2. Temperature Management Plans submitted by the Operator and approved by the Agency;
3. Documented Agreement with decisions by the Interagency Implementation Plan Committee (IIPC).

401 Certification

The load allocations for the PUD dams on the mid Columbia River will be incorporated into the FERC 401 Certifications. Participation in the Water Quality Planning Team (or the WQT) will be a condition of 401 Certs, particularly where the LA cannot be consistently met by the dam operator without new activities to reduce temperatures in the impounded reservoir. Schedules of compliance may be included in the Certs or through an independent state water quality administrative order that specify submittals of reports and updates toward progress in complying with the load allocations. See Appendix for the schedule.

Temperature Management Plans

The most stringent water quality criteria for temperature that is driving the need for the greatest temperature reductions in impoundments is the Oregon State criteria for a maximum 0.14° C increase over natural background from the period from August 1 to November 1. Also included in the water quality standards for Oregon State is the ability to demonstrate compliance with the standard in the short term by preparing and implementing a Temperature Management Plan. Since facilities and dam operators in Idaho and Washington State are subject to meeting the

water quality standards of Oregon State, it is also fair to offer them this short term opportunity to demonstrate compliance.

The state of Oregon will consider approval of submittals from the COE dams along the Oregon /Washington border. Plans submitted to Oregon to satisfy the Oregon standard may also address measures that are proposed to meet the criteria from Washington state that drive the seasonal allocations between November 1 and February 1. The state of Washington will consider approval of submittals from the other dams within the study area. Plans submitted to Washington to satisfy the Oregon standard should also address measures that are proposed to meet the criteria from Washington state that drive the seasonal allocations between November 1 and February 1. The Spokane and Colville Tribes will be included in the approval process for Submittals from Grand Coulee Dam.

All dam operators are required to design and implement a monitoring system at its dam. Temperature monitoring results from the first two seasons of monitoring will be compared to the modeled natural river thirty year average temperatures (Nt). If the current temperatures exceed the Nt, the dam operator is required to submit a temperature management plan to the respective state. The surface water temperature management plan describes the best management practices, measures, and/or control technologies which will be used to reverse the warming trend of the impoundment upstream of its dam. The plan shall be submitted before the next monitoring season.

Dam operators shall continue to maintain and improve, if necessary, the surface water temperature management plan in order to maintain the cooling trend until the numeric criterion is achieved or until the Department has determined that all feasible steps have been taken to meet the criterion and that the designated beneficial uses are not being adversely impacted.

A dam operator in compliance with the approved surface water temperature management plan and fully participating in the Implementation Workgroup shall not be deemed to be causing or contributing to a violation of the numeric criterion even if the surface water temperature exceeds the criterion.

Documented Agreement with Decisions by the Interagency Implementation Plan Committee:

An option, in lieu of individual facility temperature management plans would be for operators and agencies to document their agreement with on-going decisions of the IIPC. The participation and implementation of actions recommended by the group and approved by the state or tribe with regulatory authority constitutes the equivalent of a temperature management plan.

Joint WQS Amendment Process [place in appendix]

Long Term

This phase will begin in 2010 and proceed through 2016. Actions taken in the previous phase will be reviewed for their efficacy in improving temperature levels.

Implementation methods for these actions will be provided in a Detailed Implementation Plan, or equivalent.

Reasonable Assurance

This Summary Implementation Strategy is following the guidance in "Final Report of the Federal Advisory Committee on the Total Maximum Daily Load (TMDL) Program, July 28, 1998". That report recommends that in instances where large existing dams which are impossible or virtually impossible to remove cause water quality problems, states should not impose extensive burdens on sources where the reductions accomplished will not significantly contribute to attainment of water quality standards. Instead, the report recommends, that the states proceed on the assumption that a feasible TMDL can be developed : establish load allocations for the dams, lay out specific implementation steps within a relatively long timeframe, monitor the success of implementation and as a last resort amend the water quality standards via a use attainability analysis.

Adaptive Management

The process for reviewing the status of implementation of this TMDL will follow the timing and process for the review of the federal Biological Opinion in 2010. The Water Quality Team made up of representatives of tribes and federal and state agencies will evaluate appropriate temperature control activities for this TMDL. Based on these findings, further studies may be needed, and temperature reduction activities will be redirected or accelerated if needed.

The water quality criteria for the protection of beneficial uses may change in the future. When these changes occur, the wasteload and load allocations may be adjusted if needed to satisfy the new criteria.

Monitoring Strategy

Monitoring for TMDL compliance will consist of two components: long-term effectiveness monitoring, and short-term implementation monitoring. A monitoring strategy is described below, and the DIP will contain a detailed description of monitoring. Prior to monitoring, a Quality Assurance Project Plan should be developed and approved by Ecology.

Long-term effectiveness monitoring will focus on evaluating many years of temperature data to determine trends and compare to TMDL allocations. Existing fixed monitoring station sites can be used for this purpose, or new monitoring stations can be established. The current fixed monitoring station temperature monitoring system, which consists of tailrace and forebay monitoring stations at each mainstem Snake and Columbia River dam, should be evaluated for their representativeness for effectiveness monitoring.

Short-term implementation monitoring will be established to evaluate specific implementation activities. As those activities are identified and plans developed, a monitoring component should also be developed for management of the activity. For example, target temperatures may be developed for management of the cold-water release from an upstream reservoir. The implementation monitoring for this activity would look at the success of meeting the target temperatures, while the long-term effectiveness monitoring would look at the overall effectiveness of this and other implementation activities over the long run.

Additional monitoring may also be needed to evaluate localized effects such as hot spots or cold water refugia that impact fish habitat needs. Detailed cross sectional and vertical transect temperature studies will be encouraged during the implementation phase to assess localized temperature effects of operational strategies and to support refined temperature modeling.

Short-term compliance and the effective of operational implementation actions will be monitored at existing fixed monitoring station sites. The current fixed monitoring station temperature monitoring system consists of tailrace and forebay monitoring stations at each mainstem Snake and Columbia River dam.

Detailed cross sectional and vertical transect temperature studies will be encouraged during the implementation phase to assess localized temperature effects of operational strategies and to support refined temperature modeling.

Potential Funding Sources

Funding for structural changes to the dam projects that directly benefit endangered species recovery through temperature reduction remains a possibility. Structural changes at some federal projects may require authorization from congress and all federal funding is subject to congressional approval. Funding for capital projects that are not linked to ES survival is uncertain.

Cultural Resources

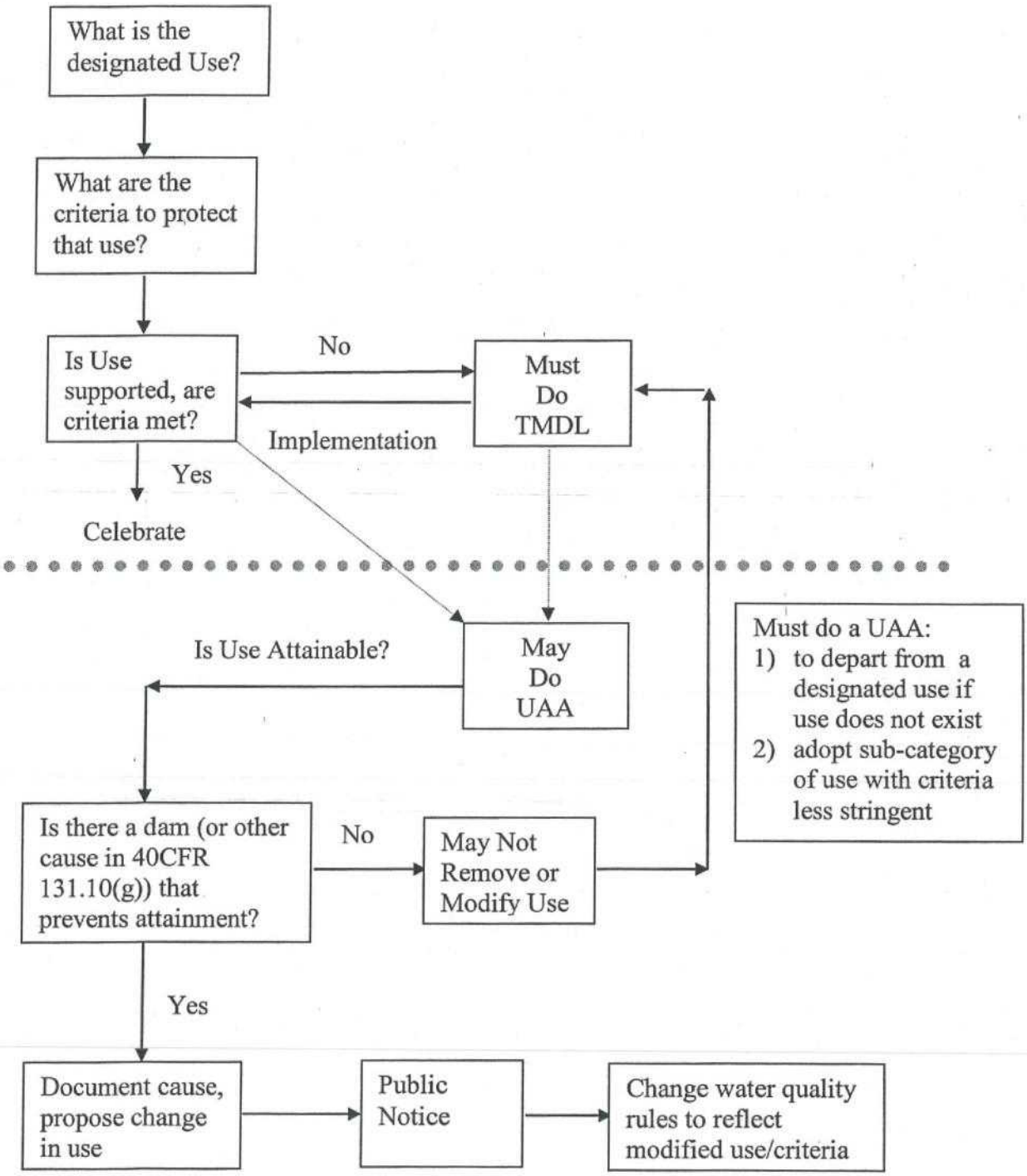
During the collaborative process of developing a DIP, the group will recognize the cultural resources that could be impacted by the measures being considered to reduce water temperature in the mainstem. As measures are evaluated for the costs, benefits, and impacts on other uses of the river, cultural resources, particularly those of the tribes in the region, will be considered. The tribes intend to be active participants in the implementation planning process and will provide

the group with the necessary information about the impact of potential measures on tribal cultural resources.

Implementation Plan Schedule

March, 2003	System-wide preliminary operational alternatives proposal from App B SIS subcommittee
May, 2003	System-wide operational alternatives recommended by WQT
June, 2003	TMDL with SIS/Water Quality Management Plan issued
Ongoing	WLAs incorporated into wastewater discharge permit decisions
March, 2004	System-wide revised operational alternatives proposal from WQT
May, 2004	System-wide operational alternatives recommended by WQT
March, 2006	Individual dam Temperature Management Plans due

Use is designated in rule



M = will address cost-sectional ave temp
S = address site-specific problems - fish handling facilities mostly
L = Research, studies - answer questions.

Action Item #	Mainstem Cooling Water Temperature Measures	Anticipated Effect on Temperature and other Benefits to Salmon Recovery	Major Issues or Concerns	Lead Agency	Feasibility of Implementation	Appropriate Next Step	Tests/Studies Required to Implement	Status/ Year(s)	NMFS 2000 FCRPS RPA
M-1	Operate Dworshak Reservoir to Release cool water in July and August to Aid juvenile migration and reduce mainstem Snake River Water Temperatures	Reduction of Water Temperature in the Mainstem Snake and Clearwater Rivers During July and August	- Possible Negative Impact on Growth of Juvenile Fall Chinook - Balancing of Reservoir Elevations vs. Augmentation of flows - Possible Impacts to Adult Salmonid Migration (positive or negative) - TDG Issues with discharge rate - Possible effects to Bull Trout - Further Discussion of effects can be found in the SOR EIS	Corps	Feasible	See Action Item 2	None - Implemented Yearly	Tested In 1991, In operation since 1992	19
M-2	Examine the Benefits of Drafting Dworshak an Additional 20 Feet during September to provide cool water to the mainstem Draft Document 1/29/2003	Reduction of Water Temperature in the Mainstem Snake and Clearwater Rivers During September	- Possible Conflict with NMFS 2000 FCRPS BIOP RPA 18 in that Refill Risk to April upper Flood Control Rule Curve is increased. However, NMFS feels there is an acceptable risk of refill to the June 30 full pool. - TDG Issues with discharge rate - The Nez Perce Tribe is concerned with drawdown exposing cultural resources to potential looting or other damage - Idaho does not favor additional impacts to recreation at Dworshak - Further Discussion of drafting dworshak below 1520 can be found in the SOR EIS	Corps	Feasible	Data Analysis and Report of the first year of study (See Action Item 5)	One year of study done, Implementation needs to be studied	A Field Test was Completed in 2002	34
M-3a	Operate the Four Lower Snake River Reservoirs within 1 foot of MOP from April through roughly October	This is thought to reduce the water surface areas exposed to solar radiation and increase water velocities to limit time exposure to solar radiation	- For 2003, Snake River Dredging Litigation may cause operations of Lower Granite Reservoir to exceed MOP+1 for navigation - Decreased Power Generation and system flexibility - Further discussions of the effects can be found in the SOR EIS	Corps	Feasible	None	None - Implemented Yearly	In Progress	20

Action Item #	Mainstem Cooling Water Temperature Measures	Anticipated Effect on Temperature and other Benefits to Salmon Recovery	Major Issues or Concerns	Lead Agency	Feasibility of Implementation	Appropriate Next Step	Tests/Studies Required to Implement	Status/ Year(s)	NMFS 2000 FCRPS RPA
M-3b	Operate the Four Lower Snake River Reservoirs below MOP, (e.g. at MSL 710 at LGR) or Spillway Crest from April through roughly October Draft Document 1/29/2003	This would further reduce the water surface areas and increase water velocities to limit time exposure to solar radiation	- Temporary draw downs are expected to have continual negative impacts to salmonids - Negative Biological Impacts to Reservoir - Negative Impacts to Navigation/Hydropower/Infrastructure - Negative Impacts to Cultural Res. - Further discussions of the effects can be found in the 1992 Columbia River Salmon Flow Measures Option Analysis/EIS	Corps	Not Feasible	None	Done	Studied in 1992	-
M-3c	Remove the four Lower Snake River Dams	This would further reduce the water surface areas exposed to solar radiation and increase water velocities to limit time exposure to solar radiation	- Discussions of the effects can be found in the 2002 Lower Snake River Juvenile Salmon Migration Feasibility Study	Corps	Not Warranted at this Time Under ESA	None Anticipated for CWA	Done	Study Completed in 2002	-
M-3d	Draw down of John Day Reservoir to spillway Crest or Natural River	This would reduce the water surface areas and increase water velocities to limit time exposure to solar radiation	- Discussions of the effects can be found in the 2000 John Day Drawdown Study - Cost Prohibitive	Corps	Not recommended	None	Done	Study Completed in 2000	-
M-4	Grand Coulee Powerhouse Operations Draft Document 1/28/2003	Selective operation of the Left, Right, and Third Powerhouses would be evaluated to determine if there is potential to cool Grand Coulee releases during critical periods.	- Power Constraints may limit benefits – stratification breaks up in September	BOR	Unknown	Decision to Proceed with Study	Modeling of Water Quality Benefits/Estimate Costs	Planning	-
M-5a	Realign Water Intakes in Federal Storage Reservoirs for Selective withdrawal	Selective Withdrawal has been demonstrated at various locations to draw water from a cooler layer in a reservoir and deliver that cooler water downstream	- Except for Grand Coulee (See action Item 9b) there are no other federal projects that could reduce water temperature in the mainstem Columbia and Snake River. - Currently exists at Dworshak Dam	Corps	Not Feasible at ROR projects	Action Item 9b	No Additional Action	None	-
M-5b	Penstock selective withdrawal at Grand Coulee - possibly similar to a Lake Shasta scenario	Selective Withdrawal has been demonstrated at various locations to draw water from a cooler layer in a reservoir and deliver that cooler water downstream	- Implementation Authority, Possible Resident Fish Constraints in FDR Lake - Possibly Cost Prohibitive	BOR	Unknown	Decision to Proceed with Study	Modeling of Water Quality Benefits/Estimate Costs	Planning	-

Action Item #	Mainstem Cooling Water Temperature Measures	Anticipated Effect on Temperature and other Benefits to Salmon Recovery	Impacts or Issues	Lead Agency	Feasibility of Implementation	Appropriate Next Step	Tests/Studies Required to Implement	Status/ Year(s)	NMFS 2000 FCRPS RPA
M-6	Alter the Flood Control Rule Curves	Currently, storage projects are prioritized to fill by June 30 (RPA 18), which maximizes the amount of water to be released in July and august for salmon flows and temperature reduction flows. It is anticipated that any change to release flood control storage would result in more water in the spring since the priority now is refill by the 30th. Therefore, it is anticipated that no additional benefit for reducing mainstem temperatures would occur due to this action.	- TBD, but a t a minimum, augmentation versus reservoir refill, and impacts to the flood plains	Corps	TBD	Federal Appropriation for a Study has been sought	Study Required	TBD	35
M-7	Investigate cool water releases from Canadian hydro projects	US Agencies are not aware of the potential for temperature augmentation associated with releases of water from Canada	- Unknown, however, at a minimum, similar concerns with the Dworshak releases - No Authority	Unknown	Unknown	TBD	TBD	TBD	-
M-8	Investigate the cool water releases from the Hell's Canyon hydro projects	The Hell's Canyon projects are thought to have some stratification in them during some times of the year, with selective withdrawal, it may be possible to tap a layer of water for downstream cooling effects	- Unknown, however, at a minimum, similar concerns with the Dworshak Reservoir releases - No Authority	Unknown	Unknown	TBD	TBD	TBD	-
M-9	Banks Lake Selective Withdrawal Draft Document 1/28/2003	Drawing water from the upper part of the water column into Banks lake may make more, cooler water available in the Mainstem river.	- Implementation Authority -Temp. Constraints in Banks Lake - Possible Resident Fish Constraints in FDR Lake	BOR	Unknown	Decision to Proceed with Study	Modeling of Water Quality Benefits/Estimate Costs	Planning	-
M-10	Investigate Groundwater Charging for Cooling Mainstem Water	Charging groundwater in strategic areas may provide areas of upwelling of cooler water from the river bottom, providing cool water refugia and helping to reduce overall river temperature							

Action Item #	Site Specific Water Temperature Measures	Anticipated Effect on Temperature and other Benefits to Salmon Recovery	Major Issues or Concerns	Lead Agency	Feasibility of Implementation	Appropriate Next Step	Tests/Studies Required to Implement	Status/ Year(s)	NMFS 2000 FCRPS RPA
S-1	Modification of Dworshak National Fish Hatchery Water Supply	No change to the reaches affected by the Dworshak Temperature Releases unless cooler water can be released due to modifications at hatchery.	- benefits to the Dworshak hatchery water supply - If cooler water is released, need to consider impacts to juvenile salmon rearing	Corps	Feasible	None	Done	In Progress To be Completed in 2003	33
S-2a	Examine the temperatures in the McNary Forebay to determine if there are options to reduce water temperatures in the juvenile bypass systems	Better Understanding of Impacts to Juvenile Salmon Survival related to temperature. Using mixers in the forebay or excavating the shallow water of the forebay on the South Shore may help to disrupt the temperature gradient that occurs there	- Turbine discharge limited -Feasibility of excavation has not yet been evaluated	Corps	Feasible	Complete analysis and Report	Studies in Progress	In Progress	142
S-2b	Identify water temperature cooling methods at individual projects for juvenile fish passage	Drawing water through specific turbines has been shown to draw cooler water into juvenile fish facilities at McNary Dam	- If a problem is discovered, implementation of a solution would also need to be studied	Corps	TBD	Complete analysis and Report	Nothing Scheduled	None	141
S-2c	Identify methods to cool river water temperature at individual projects	Selective Operations at various facilities may have potential for cooling the river (See Action 7d)	- If a problem is discovered, implementation of a solution would also need to be studied	Corps	TBD	Complete analysis and Report	Study in Progress at Chief Joseph Dam	In Progress	-

Action Item #	Research Related Water Temperature Measures	Anticipated Effect on Temperature and other Benefits to Salmon Recovery	Major Issues or Concerns	Lead Agency	Feasibility of Implementation	Appropriate Next Step	Tests/Studies Required to Implement	Status/ Year(s)	NMFS 2000 FCRPS RPA
R-1	Acoustic and Radio Data Storage Tag studies to examine migratory behavior of adults with respect to temperatures and depth. Tracking data should overlay on simulated physical conditions.	Better Understanding of Impacts on Adult Salmon Behavior related to Temperature Releases	- If a problem is discovered, implementation of a solution would also need to be studied - Continued Dworshak Operations	Corps	Feasible	Complete Study, Analysis and Report	Study in Progress, 2003 last anticipated year of field study	Ongoing 2000-2003	34, 115
R-2	Studies to Examine the water temperature in adult fish ladders	Better Understanding of Impacts on Adult Behavior related to temperature	- If a problem is discovered, implementation of a solution would also need to be studied	Corps	Feasible	Complete analysis and Report	Study In Progress	In Progress	114
R-3a	Additional Monitoring of Water Temperatures in the Snake River and model investigations to evaluate alternative operations of Dworshak	Better Understanding of Impacts of Dworshak Releases	- No Known Negative Impacts – Better understanding of river temperatures	Corps	Feasible	Complete analysis and Report	In Progress	In Progress 2002-2007	143
R-3b	Improve water temperature monitoring of the Columbia River	This action is being performed concurrently with Action Item 8a	- Better understanding of river temperatures	Corps BPA BOR	Feasible	Complete analysis and Implement	Study In Progress for TDG	In Progress	-
R-4	Investigate Cool Water Refugia in the Mainstem Rivers	Determine if areas of cool water refugia exist in the mainstem rivers and determine if it is feasible to somehow try to connect these habitats							
R-5	Perform a D-Temp study (Similar to a D-Gas Study) Multidimensional								
R-6	Develop a ~~two~~ dimensional water quality model for the geographic scope of the water quality plan								
R-7	Study the relationship of temperature on fish diseases.								